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(51) INT CL[7]
E21B 43/08 , B01D 29/00 , E21B 43/10

(52) UK CL (Edition T)
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(56) Documents Cited by ISA
None

(58) Field of Search by ISA
NOT YET ADVISED

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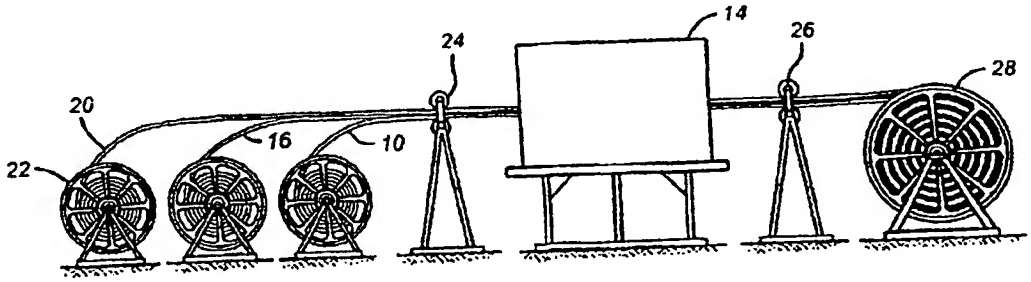
(54) Abstract Title
Multi-layer screen and downhole completion method

(57) A downhole completion method and an expandable filtration apparatus are disclosed. The filter assembly comprises a plurality of layers beginning with a coated perforated base pipe. The coating reduces the force required for expansion. A drainage layer overlays the base pipe with the filtration layer above it. The drainage layer improves flow through the filtration layer and protects it from burrs in the base pipe. A filtration enhancement layer fits over the filtration layer and an outer shroud protects the assembly during run in. The assembly can be used as made or expanded downhole in one or a series of expansions.



GB 2 374 098 A

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(51) International Patent Classification[7]: E21B 43/08, 43/10, B01D 29/00

(21) International Application Number: PCT/US01/27581

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6 September 2001 (06.09.2001)

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(30) Priority Data:

60/231,627	11 September 2000 (11.09.2000)	US
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60/287,626	30 April 2001 (30.04.2001)	US

(71) Applicant: **BAKER HUGHES INCORPORATED** [US/US]; Suite 1200, 3900 Essex Lane, Houston, TX 77027 (US).

(72) Inventors: **VOLL, Benn, A.**; 6706 Fawncliff Drive, Houston, TX 77069 (US). **PETERSON, Rick**; 206 Bell Maison, BSC, Lafayette, LA 70506 (US). **BROOME, John, T.**; 55 South Bristol Oak Circle, The Woodlands, TX 77382 (US). **DYSON, Ken**; 5010 Main Highway, St. Martinville, LA 70582 (US). **ANGELLE, Simon**; 1972 Bushville Highway, Arnaudville, LA 70512 (US). **BAUGH, John, L.**; 7519 Plum Tree Forest Court, Houston, TX 77095 (US).

(74) Agents: **CARSON, Matt** et al.; Baker Hughes Incorporated, Suite 1200, 3900 Essex Lane, Houston, TX 77027 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(88) Date of publication of the international search report:
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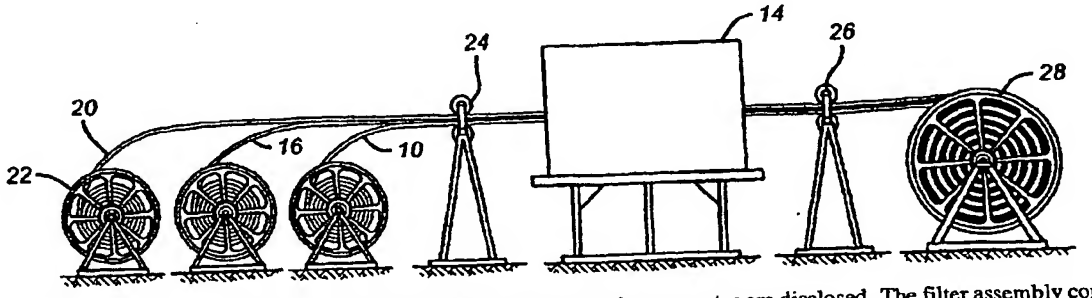
(54) Title: MULTI LAYER SCREEN FOR DOWNHOLE USE.



(57) Abstract: A downhole completion method and an expandable filtration apparatus are disclosed. The filter assembly comprises a plurality of layers beginning with a coated perforated base pipe (10). The coating (18) reduces the force required for expansion. A drainage layer (24) overlays the base pipe with the filtration layer (26) above it. The drainage layer improves flow through the filtration layer and protects it from burrs in the base pipe. A filtration enhancement layer fits (32) over the filtration layer and an outer shroud (34) protects the assembly during run in. The assembly can be used as made or expanded downhole in one or a series of expansions.

WO 02/023009 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/27581

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B43/08 E21B43/10 B01D29/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 336 383 A (BAKER HUGUES INCORPORATED) 20 October 1999 (1999-10-20) claim 1 page 5, line 18 - line 20	1
A	US 4 483 399 A (COLGATE) 20 November 1984 (1984-11-20) column 6, line 59 - line 63 column 7, line 8 - line 11 claim 3	1
A	US 3 680 183 A (SUNDBERG) 1 August 1972 (1972-08-01) column 14, line 15 - line 27 column 7, line 42 - line 46 column 2, line 12 - line 21	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July 2002	09. 08. 2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	SOGNO, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/27581

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 979 551 A (UBAN) 9 November 1999 (1999-11-09) column 1, line 54 - line 66	1
A	WO 00 50733 A (SHELL OIL COMPANY) 31 August 2000 (2000-08-31) page 6, line 10 - line 15 page 1, line 24 - line 28	15,16
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/27581

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	US 6 354 373 B1 (VERCAEMER) 12 March 2002 (2002-03-12) abstract	20
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/27581

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-14

   Expandable filter assembly for downhole use,comprising at least one annealed filtration layer.

2. Claims: 15-19

   Expandable filter asembly for downhole use, comprising at least one filtration layer which is mounted on a coated pipe.

3. Claims: 20-23

   Expendable filter assembly for downhole use, comprising at least one filtration layer and an expander capable of multi-stage expansion.

4. Claims: 24,25

   Expandable filter assembly for downhole use, comprising at least one filtration layer including a weave having weft and warp wires.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 01/27581

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International Bureau

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21 March 2002 (21.03.2002)

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(51) International Patent Classification[7]: E21B 43/08, 43/10, B01D 29/00

(21) International Application Number: PCT/US01/27581

(22) International Filing Date: 6 September 2001 (06.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

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60/287,626	30 April 2001 (30.04.2001)	US

(71) Applicant: BAKER HUGHES INCORPORATED [US/US]; Suite 1200, 3900 Essex Lane, Houston, TX 77027 (US).

(72) Inventors: VOLL, Benn, A.; 6706 Fawncliff Drive, Houston, TX 77069 (US). PETERSON, Rick; 206 Bell Maison, BSC, Lafayette, LA 70506 (US). BROOME, John, T.; 55 South Bristol Oak Circle, The Woodlands, TX 77382 (US). DYSON, Ken; 5010 Main Highway, St. Martinville, LA 70582 (US). ANGELLE, Simon; 1972 Bushville Highway, Arnaudville, LA 70512 (US). BAUGH, John, L.; 7519 Plum Tree Forest Court, Houston, TX 77095 (US).

(74) Agents: CARSON, Matt et al.; Baker Hughes Incorporated, Suite 1200, 3900 Essex Lane, Houston, TX 77027 (US).

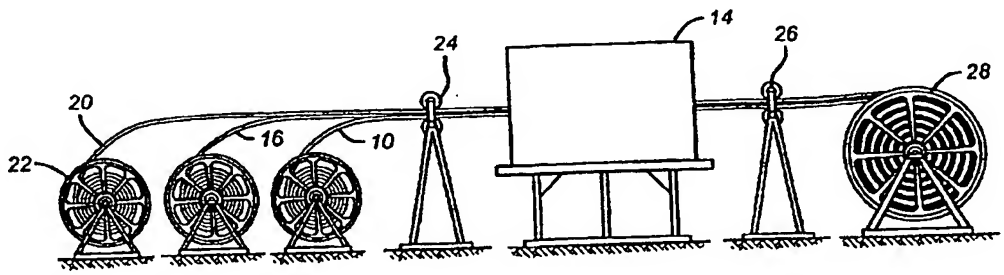
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTI_LAYER SCREEN AND DOWNHOLE COMPLETION METHOD



(57) Abstract: A downhole completion method and an expandable filtration apparatus are disclosed. The filter assembly comprises a plurality of layers beginning with a coated perforated base pipe. The coating reduces the force required for expansion. A drainage layer overlays the base pipe with the filtration layer above it. The drainage layer improves flow through the filtration layer and protects it from burrs in the base pipe. A filtration enhancement layer fits over the filtration layer and an outer shroud protects the assembly during run in. The assembly can be used as made or expanded downhole in one or a series of expansions.

WO 02/23009 A2

Title: MULTI_LAYER SCREEN AND DOWNHOLE COMPLETION METHOD

Field of the Invention

[0001] The field of this invention relates to downhole screens, which can be expanded into contact with the formation.

Background of the Invention

[0002] Downhole screens are used in a variety of different applications. As part of a common procedure called gravel packing, the screens are deposited adjacent the producing formation and the surrounding annular space is filled with sand known as gravel. Various fabrication techniques have been developed for manufacturing such screens and a typical example is illustrated in US Patent 5,611,399.

[0003] More recently it has been determined that it is desirable to reduce the size of the annular space between the screen and the formation. Reduction of the volume of the annular space around the screen discourages fluid flow along the screen, which, in turn, lessens the production of sand. In order to be able to produce the reservoir longer, it has been desirable to insert screens in well bores or laterals and thereafter expand them. A good example of the expansion techniques for a downhole screen is shown in U.S. Patent 6,012,522. In this patent, overlapping segments of screen are

placed on a base pipe, which is ultimately expanded from within when placed in position in the well bore or a lateral. The shortcoming of this technique is that portions of the filtering material must be moved relative to each other which subjects them to tearing which in turn can result in a failure of the expanded screen assembly to control the production of sand. Another shortcoming of such designs is the limited capacity to withstand collapse.

[0004] Other patents relating to pipe expansions are: U.S. Patent 5,901,789 and 5,366,012.

[0005] The main objective of the present invention is to allow easy installation of the screen to the desired location followed by expansion to reduce the volume of the annular space around the screen. Yet another object of the invention is to expand the screen against the formation to entirely eliminate the annular space around it. Yet another objective of the present invention is to allow the use of the structure of the screen downhole even without expansion. Another objective of the present invention is to decrease the amount of stress on the filtration member when expanded. Yet another objective of the present invention is to provide a significantly stronger structure for the finished product, which even after expansion presents a greater resistance to collapse. Another object of the invention is to provide, as much as possible, uniformity in the opening size of the filtration layer after the assembly is expanded. Another objective is to provide sufficient strength in the assembly, after expansion to allow it to better resist differential pressures. Still another objective is to reduce the effort required for expansion and to stage the overall expansion in discrete steps. These and other advantages of the present invention will be appreciated by

those skilled in the art from a review of the description of the preferred embodiment, which appears below.

SUMMARY OF THE INVENTION

[0006] A downhole completion method and an expandable filtration apparatus are disclosed. The filter assembly comprises a plurality of layers beginning with a coated perforated base pipe. The coating reduces the force required for expansion. A drainage layer overlays the base pipe with the filtration layer above it. The drainage layer improves flow through the filtration layer and protects it from burrs in the base pipe. A filtration enhancement layer fits over the filtration layer and an outer shroud protects the assembly during run in. The assembly can be used as made or expanded downhole in one or a series of expansions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 is cutaway view, partly in section, showing the filter assembly.

[0008] Fig. 2 is a section view along lines 2_2 of Fig. 1.

[0009] Fig. 3 is a section view of a first step in a multi step expansion of the filter assembly.

[0010] Fig. 4 is a section view of a second step in a multi step expansion of the filter assembly

[0011] Fig. 5 is a comparison performance chart comparing a known filter made by Baker Hughes called Excluder and two variations of the filter, of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] Referring to Fig. 1, the various layers of the preferred embodiment are shown. The innermost layer is a perforated base pipe 10, which has a plurality of openings 12. Base pipe 10 provides a firm foundation for the layers above. The pattern of the holes 12 is optimized to strike the best balance between collapse resistance after expansion and minimization of the force required to expand this layer and those positioned outside it, as will be described below. This optimization allows expansions in the range of up to about 30%. The base pipe 10 can have threads 14 and 16 at opposite ends to allow sections of the filter assembly A to be secured together, giving greater torsion and tension strength for the filter assembly A. A coating 18 made preferably from a plastic material can be applied to the inside of the base pipe 10. The Whitford Corp. manufactures the coating under the name Xylan 1052.Ultimately, when an expander 20 (see Fig. 3) is moved through base pipe 10, the coating 18 will reduce the required expansion force. The greater collapse resistance of the base pipe 10 promotes borehole stability after expansion. The optimization of the openings 12 promotes the highest expansion rate for a given material for base pipe 10 while still leaving sufficient inflow area through the pipe openings or perforations 12. Using round, rounded, or oval opening instead of slots provides for a mechanically stronger filter assembly A. In the preferred embodiment, the coating 18 is Xylan and it can provide a reduction in required force for a given expansion by as much as 50%. The coating 18 also helps resistance to galling by the expander 20 or a subsequent expander such as 22 (see Fig. 4).

[0013] Mounted above the base pipe 10 is a drainage layer 24. Drainage layer 24 is between base pipe 10 and filtration layer 26. The drainage layer 24 promotes flow

between the filtration layer **26** and the openings **12** of the base pipe **10**. In the preferred embodiment, the drainage layer **24** is a weave, selected from a broad array of metals. A braided weave design is currently preferred, although other weave patterns can be used. The preferred material is available from Jersey Hose as _ 6" 304 SS Braid 600_304B. The drainage layer **24** protects the filtration layer **26** from burrs or puckers around the edges of openings **12**. In the event of high differential pressures due to production, the presence of the drainage layer **24** provides structural support for the filtration layer **26**. The braided wire drainage layer **24** could be substituted with a shroud of some type, akin to outer shroud **34**, that would have standoff from the base pipe **10**.

[0014] Mounted over the drainage layer **24** is the filtration layer **26**. The filtration layer **26** has uniform openings. The preferred material is a special type of Twill Dutch weave. This material gives very reliable uniformity to the opening size, after expansion. In this manner there can be confidence in the particle size, which will not pass filtration layer **26** while giving greater protection against plugging or the passage of too many particles. As shown in Fig. **1**, the filtration layer **26** is oriented at an angle to the longitudinal axis of the filter assembly **A**. This angle can be in the range of about 10 to about 80 degrees with about 20 degrees being preferred. Orienting the filtering layer **26** at an angle allows minimization of change in opening size and uniformity, resulting from expansion. The Dutch Twill weave provides greater durability and particle holding capacity. Negative effects on hole size and uniformity as a result of expansion are further minimized by using a reverse weave Twill Dutch pattern. A reverse weave is one where the diameter of the weft (shute) wires **28** is

larger than the warp wires 30 by as much as about 50 percent. The combination of the angular placement of the filtration layer 26 by a spiral winding technique coupled with a reverse weave yields a more predictable and uniform opening size after expansion.

[0015] Mounted over the filtration layer 26 is the filtration enhancement layer 32. This layer promotes greater flow conductivity from the outermost layer, the outer shroud 34. Layer 32 acts as a coarse filter to layer 26 and prolongs the life of filtration layer 26. This can be seen in the graph of Fig. 5, where the addition of the filtration enhancement layer is curve 36. The same filter assembly A of the present invention but without the filtration enhancement layer 32 is illustrated by curve 38. Curve 40 represents the performance of a known product made by Baker Hughes called Excluder. Fig. 5 readily demonstrates that the addition of the filtration enhancement layer 32 nearly triples the time it takes to build up a backpressure of 40 PSIG for the same flow conditions. Leaving out the filtration enhancement layer 32 also makes that version of the present invention perform somewhat comparably to the known Excluder design. Several different weave types are suitable for layer 32 such as: square weave, Compound Balanced, Tight Tuck, and Braided Weave. A suitable Compound Balanced material is available from Porous Metal Products, model # CB_3_96_192_21/24. A metallic material is preferred.

[0016] The outer shroud 34 is preferably formed from spirally winding a perforated sheet into a tube. The hole size and pattern is optimized to facilitate expansion and yet provide sufficient collapse resistance in the expanded state. It is desired to have the inflow area of the openings maximized but to limit the opening size and use a

staggered pattern so that the outer shroud will not buckle or tear, when expanded. The primary purpose of the outer shroud 34 is to protect the layer below from damage during run in.

[0017] The layers can be joined together by swaging to reduce the outside diameter of the filter assembly A. Swaging also makes the various layers act as one with regard to expansion and provides greater strength against collapse after expansion. It is preferred to anneal the components individually before swaging or to anneal the filtration assembly A after all the components have been assembled. Doing this permits a greater degree of expansion without failure. This benefit is particularly applicable to the base pipe 10. The type of annealing envisioned is solution annealing to 1800 degrees F. Annealing of the base pipe 10 is done before applying the coating 18 due to the inability of the coating 18 to withstand the annealing temperatures. Sintering can be used instead of swaging to join the layers together. The layers are preferably assembled in the following manner: the braided wire of suitable drainage layer 24 is placed on the base pipe 10 which has previously been drilled with holes, coated and threaded. Then, the filtration layer 26 is wrapped at an angle over the top of the drainage layer 24. Another layer, called the filtration enhancement layer 32 is placed over the top of the filtration layer 26. Then, an outer shroud 34 is placed over the filtration enhancement layer 32 and the total package is run through a set of dies that swages or forces all components to vigorously contact each other.

[0018] The filter assembly A has the advantage of superior performance, whether it is expanded downhole or not. If it is not expanded, it can be gravel packed in the known manner. Figs. 3 and 4 illustrate a unique step_wise expansion technique. In a first

step, an expander 20 which may be a fixed cone or a cone with variable diameter is moved downwardly through the filter assembly A to achieve about a 15% expansion. At the lower end of the filter assembly A a cone latch 42 engages a fixed or variable diameter expander or cone 22 to increase the overall expansion to as much as 50%. As previously stated, more expansion steps can be used and different degrees of step_wise expansion and overall expansion can be obtained with this technique. It should be noted that the second expansion does not necessarily have to proceed in a direction opposite the first expansion.

[0019] There are many applications of the filter assembly of the present invention. In horizontal open hole completions there are usually more than 1,000 feet of contact with the productive formation, sometimes in excess of 9,000'. Because there is so much contact the amount of production per foot is very low. In most cases if the theoretical production per foot was traveling into a screen directly opposite of the formation then the velocity would be too low to transport sand from unconsolidated formations or cause erosion. There are many wells in which erosion is taking place and sand is being produced. Presently there are a couple of theories that explain this occurrence. First the formations may be so unconsolidated that they simply fall apart when the pressure in the well bore used to control the well during drilling and completing the well is removed. This is referred to as hole or formation collapse. A second possibility is that fluid flows along the path of least resistance. This may be on the inside of a screen that is in place or along the outside. As the flow proceeds towards the beginning of the open hole section, the accumulative effects of production means the velocity is much higher towards the top section (beginning) of

the open hole. This velocity (accumulated flow) can be high enough on the outside of the screen to transport sand and to erode the formation and screen.

[0020] By expanding screen in an open hole horizontal well the annulus between the screen and the formation can be greatly reduced or even eliminated.. Reduction of the annulus means greater resistance to flow and therefore production flow is reduced on the exterior of the screen and increased on the interior. The reduction in exterior flow means lower velocities near the well bore and therefore less sand transportability and less erosion effects.

[0021] Expansion can also aid in formation stability by physically supporting the formation if the screen is expanded until it is touching the formation. This support in turn could prevent the collapsing of the formation when the pressure in the well bore is reduced.

[0022] In cased hole applications filtration assembly A offers the advantage of a large inside diameter for remedial work below its installation. Another advantage is that in frac packs and gravel packs all that is necessary to do is to place the proppant or sand in the perforation tunnels and formation fractures. Annular packs between the screen and the casing, which are often difficult to achieve, are not necessary since expanding screen removes this annulus. The filter apparatus A could also be used in conjunction with a frac pack or gravel pack and subsequently expanded to back fill any voids in the annulus pack or perforations not filled.

We claim:

1. An expandable filter assembly for downhole use, comprising:

a base pipe having an inside surface, a longitudinal axis, and a plurality of openings;

at least one filtration layer mounted over said base pipe, said layers each being annealed to facilitate subsequent expansion downhole.

2. The assembly of claim 1, wherein:

said filtration layer and said base pipe are individually annealed prior to being joined together.

3. The assembly of claim 1, wherein:

said filtration layer and said base pipe are annealed after being joined together.

4. The assembly of claim 1, wherein:

said filtration layer and said base layer are swaged together and said annealing further comprises solution annealing at up to about 1800 degrees F.

5. The assembly of claim 1, wherein:

said inside surface of said base pipe is coated to reduce the force needed for subsequent expansion.

6. The assembly of claim 5, further comprising:

an expander capable of multi-stage expansion of said base pipe and said filtration layer.

7. The assembly of claim 6, wherein:

said staged expansion occurs in a single direction.

8. The assembly of claim 6, wherein:

said staged expansion occurs in opposed directions.

9. The assembly of claim 6, wherein:

said base pipe is expanded in stages up to about 30% above its original dimension.

10. The assembly of claim 6, wherein:

said filtering layer comprises a weave having weft and warp wires and wherein one of said weft and warp wires is disposed at an angle of about 10-80 degrees with respect to the longitudinal axis of said base pipe.

11. The assembly of claim 10, wherein:

said weft wires have a larger diameter than said warp wires by as much as about 50%.

12. The assembly of claim 10,wherein:

said at least one filtration layer further comprises a woven drainage layer on said base pipe and a main filtration layer, said drainage layer protecting said main filtration layer from burrs in openings in said base pipe and providing mechanical support for said main filtration layer.

13. The assembly of claim 12, further comprising:

a filtration enhancement layer mounted over said main filtration layer and further comprising a weave, said drainage layer and said filtration

enhancement layer are spirally wound to orient wires therein in substantial alignment with said wires in said main filtration layer.

14. The assembly of claim 10, wherein:

said openings in said base pipe are round, rounded or oval.

15. An expandable filter assembly for downhole use, comprising:

a base pipe having an inside surface, a longitudinal axis, and a plurality of openings;

at least one filtration layer mounted over said base pipe,

said inside surface of said base pipe is coated to reduce the force needed for subsequent expansion.

16. The assembly of claim 15, wherein:

said coating is made of a plastic material and said openings are round, rounded or oval.

17. The assembly of claim 15, further comprising:

an expander capable of multi-stage expansion of said base pipe and said filtration layer.

18. The assembly of claim 17, wherein:

said filtering layer comprises a weave having weft and warp wires and wherein one of said weft and warp wires is disposed at an angle of about 10-80 degrees with respect to the longitudinal axis of said base pipe.

19. The assembly of claim 18, wherein:

said layers each being annealed to facilitate subsequent expansion downhole;

said filtration layer and said base layer are swaged together and said annealing further comprises solution annealing at up to about 1800 degrees F.

20. An expandable filter assembly for downhole use, comprising:

a base pipe having an inside surface, a longitudinal axis, and a plurality of openings;

at least one filtration layer mounted over said base pipe; and

an expander capable of multi-stage expansion of said base pipe and said filtration layer.

21. The assembly of claim **20**, wherein:

said base pipe is expanded in stages up to about 30% above its original dimension.

22. The assembly of claim **20**, wherein:

said layers each being annealed to facilitate subsequent expansion downhole;

said filtration layer and said base layer are swaged together and said annealing further comprises solution annealing at up to about 1800 degrees F.

23. The assembly of claim **22**, wherein:

said filtering layer comprises a weave having weft and warp wires and wherein one of said weft and warp wires is disposed at an angle of about 10-80 degrees with respect to the longitudinal axis of said base pipe.

24. An expandable filter assembly for downhole use, comprising:

a base pipe having an inside surface, a longitudinal axis, and a plurality of openings;

at least one filtration layer mounted over said base pipe,

said filtering layer comprises a weave having weft and warp wires and wherein one of said weft and warp wires is disposed at an angle of about 10-80 degrees with respect to the longitudinal axis of said base pipe.

25. The assembly of claim 24, wherein:

said weft wires have a larger diameter than said warp wires by as much as about 50%.

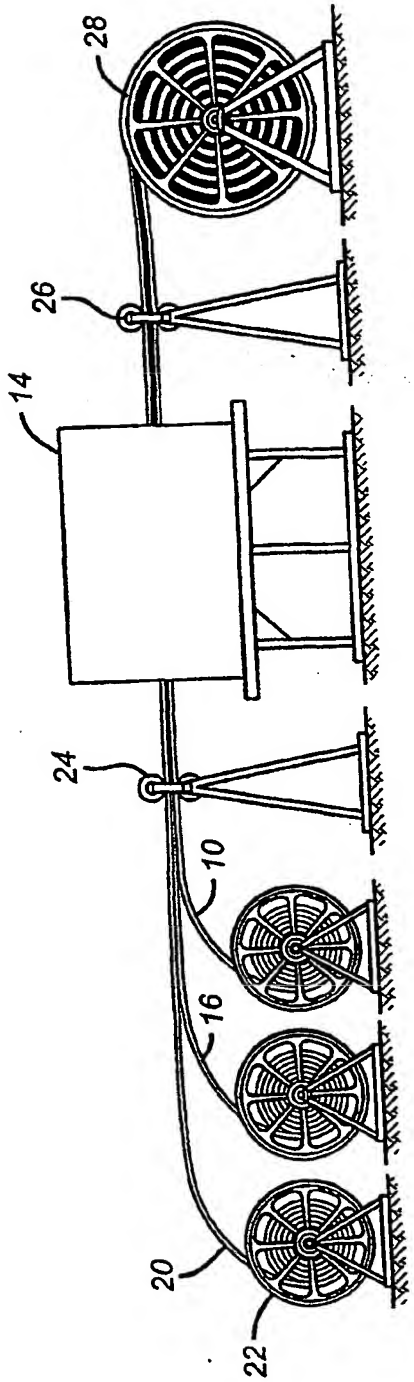


FIG. 1

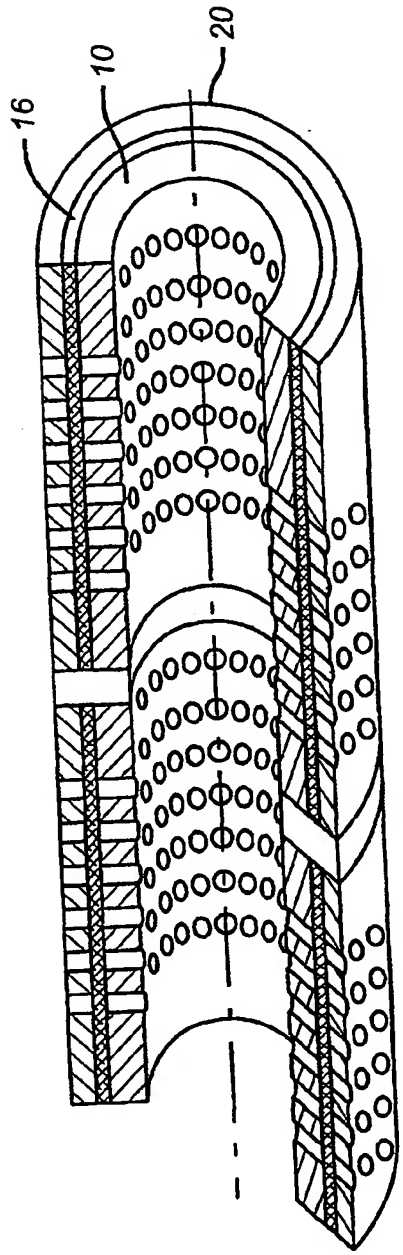


FIG. 2

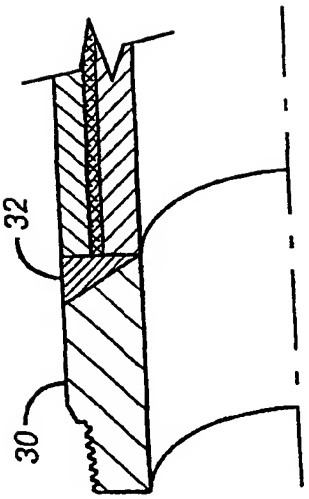


FIG. 4

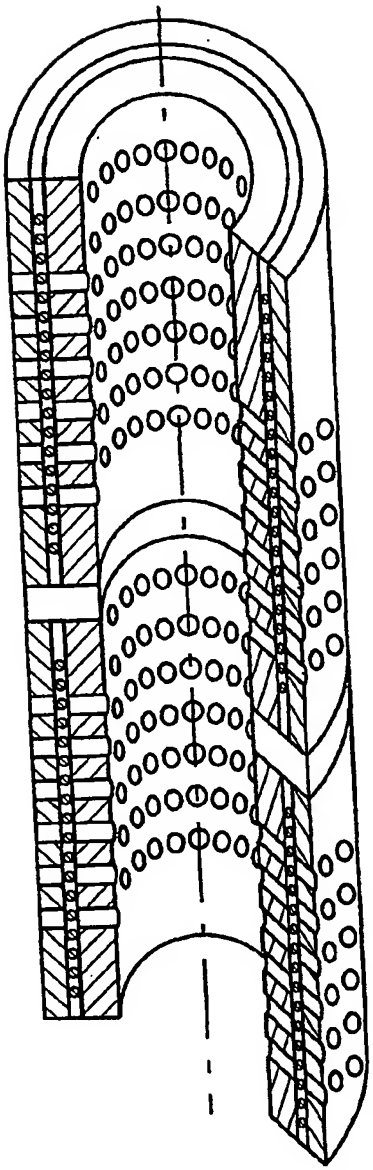


FIG. 3

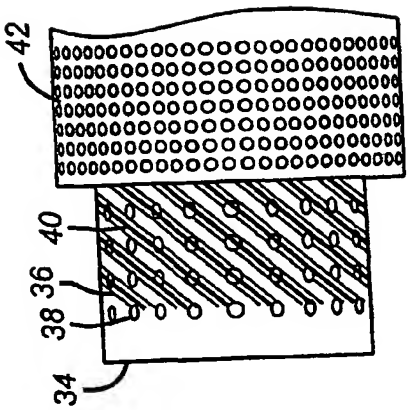


FIG. 5

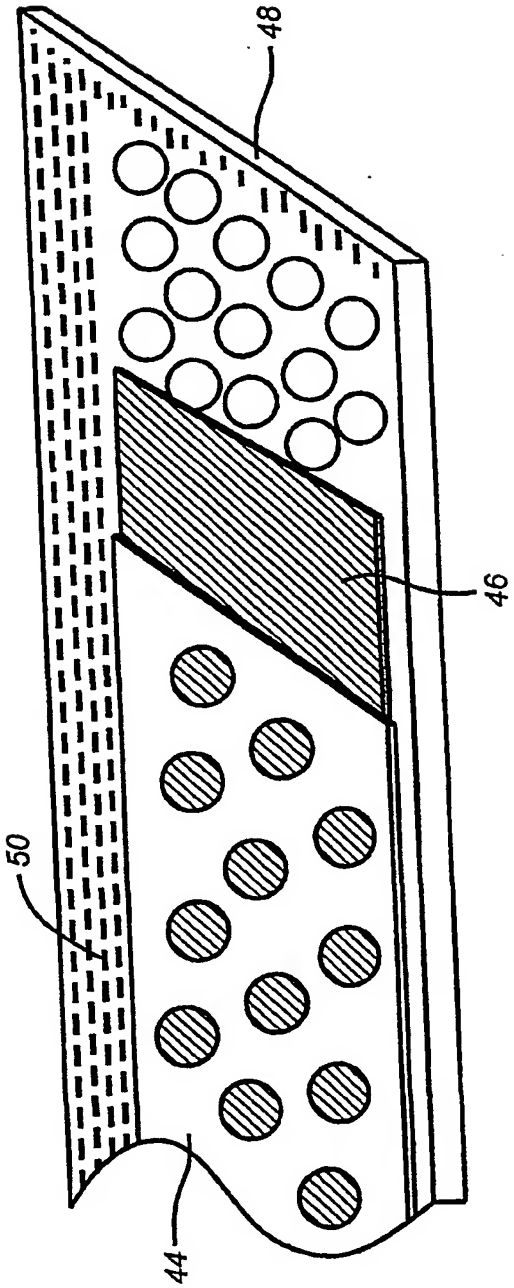


FIG. 6

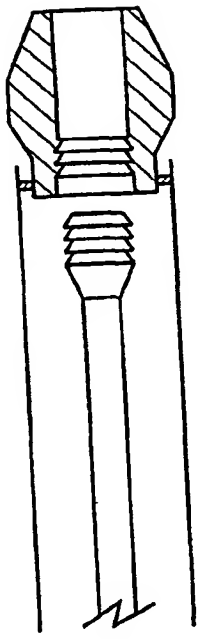


FIG. 9

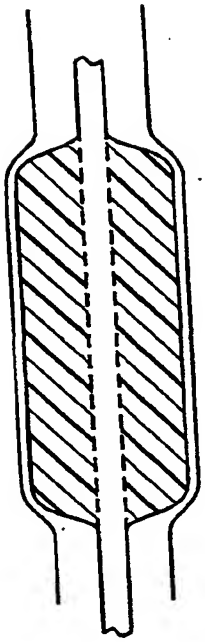


FIG. 11

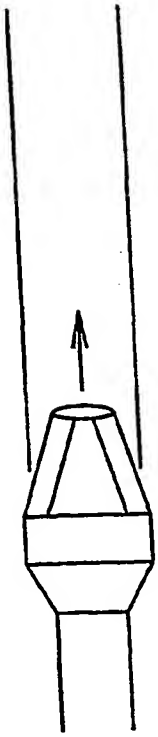


FIG. 7

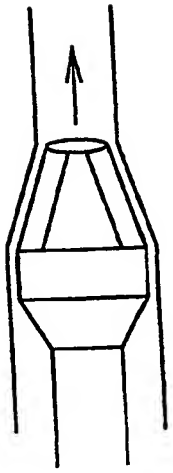


FIG. 8

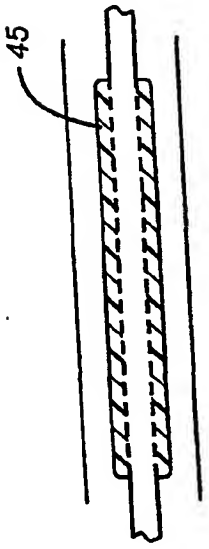


FIG. 10

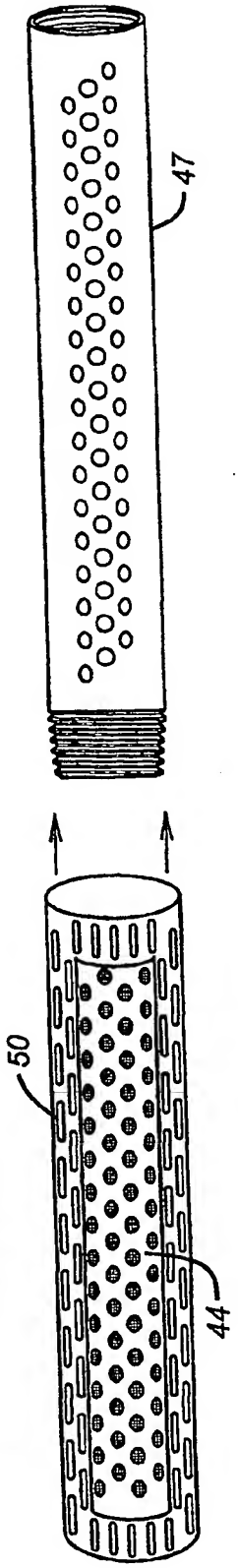


FIG. 12

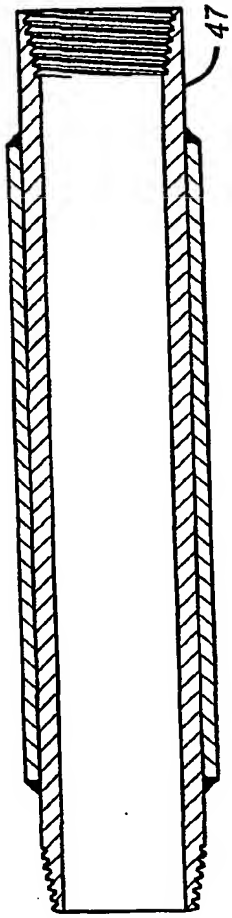


FIG. 13